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Harvest statistics for beluga in Nunavik, 2005–2008

Statistiques de chasse au béluga au Nunavik, 2005–2008

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ABSTRACT

The Nunavik communities have traditionally harvested beluga along the eastern Hudson Bay, Hudson Strait and Ungava Bay coasts of northern Quebec. Harvest statistics have been monitored over the last 35 years. Two previous reports summarized the information collected between 1974 and 2004 (Lesage et al. 2001, Lesage & Doidge 2005). The current report provides an update of this information for the period 2005–2008. Annual harvests declined progressively from an average 450 beluga/yr prior to the introduction of quotas in 1986, to 258 beluga/yr during 1986–2000, 175 beluga/yr during 2001–2004, and 161 beluga/yr during 2005–2008. Compliance with management measures improved after 2002 as indicated by a greater transmission of information through weekly reports, participation in the sampling program, and a general reduction in the total harvest in all regions of the Nunavik. In spite of these improvements, allocations were exceeded almost each year in all regions of Nunavik. Hudson Strait historically supported the largest harvests, and continued to do so during 2005–2008, with 69–92% of the Nunavik annual harvest. One noticeable change during the period 2001–2008 in comparison with previous years was the large number of communities harvesting in Hudson Strait and the appearance of harvests in non-traditional sites. Although white beluga dominated the harvest during 2005–2008, with 59% of the total catch, grey beluga, including dark grey animals, represented 41% of total catches. The sex composition of the harvest indicates that females were killed as often as, or more often than males during this period. This was particularly true for grey beluga, of which females were killed at least twice as often as males. Older beluga were relatively rare in the harvest during 1993–2008 compared with harvests conducted during the 1980s, resulting in a distribution with a median age of 19 to 20 years depending on periods, compared with 26.0 yrs in the 1980s. Beluga killed in Hudson Strait during the 1990s and 2000s were slightly older than those killed in eastern Hudson Bay during the same period.

RÉSUMÉ

Les communautés du Nunavik ont traditionnellement chassé le béluga dans l'est de la Baie d'Hudson, le Détroit d'Hudson et la Baie d'Ungava dans le nord du Québec. Les statistiques de chasse ont été colligées depuis maintenant 35 ans. Les informations récoltées entre 1974 et 2004 ont été résumées dans deux rapports précédents (Lesage et al. 2001, Lesage & Doidge 2005). Le présent rapport procure une mise à jour de ces informations pour la période 2005–2008. Le niveau de chasse a progressivement décliné d'une moyenne de 450 bélugas/an avant l'introduction des quotas en 1986, à une moyenne de 258 bélugas/an durant 1986–2000, 175 bélugas/an en 2001–2004, et 161 bélugas/an en 2005–2008. Le respect des mesures de gestion s'est amélioré après 2002, tel que l'indique une transmission accrue d'information via les rapports hebdomadaires, une meilleure participation au programme d'échantillonnage, et une réduction globale des prises dans toutes les régions du Nunavik. Malgré ces améliorations, les quotas ont été surpassés presque chaque année et dans chaque région. Le détroit d'Hudson était historiquement et demeure le lieu des plus grandes prises durant 2005–2008, représentant 69–92% des bélugas tués par les communautés du Nunavik. Un changement notable pour la période 2005–2008 par rapport aux années précédentes a été le nombre élevé de communautés chassant dans le détroit d'Hudson et l'apparition de chasse dans des aires non traditionnelles. Bien que les individus blancs aient été prépondérants dans la chasse, avec 59% de l'ensemble des prises, les bélugas gris, incluant les individus gris foncés, représentaient 41% des bélugas tués en 2005–2008. La composition de la chasse indique aussi que les femelles ont été tuées aussi souvent, sinon plus souvent que les mâles. Ceci était particulièrement vrai pour les bélugas gris, chez qui les femelles ont été tuées au moins deux fois plus souvent que les mâles. Les bélugas plus âgés étaient relativement rares dans les prises durant 1993–2008 comparé aux chasses menées durant les années 1980s, ce qui a mené à des distributions dont la médiane d'âge était de 19 à 20 ans selon les périodes, comparé à 26 ans durant les années 1980s. Les bélugas tués dans le détroit d'Hudson durant les années 1990s et 2000s étaient légèrement plus âgés que ceux tués dans l'est de la baie d'Hudson.

Introduction

The beluga, *Delphinapterus leucas*, is a medium-sized odontocete with a circumpolar distribution. In eastern Canadian subarctic waters, beluga are observed during summer along both coasts of Hudson Bay, as well as in James Bay and Ungava Bay (Figure 1). Beluga from eastern and western Hudson Bay, and possibly other regions of Hudson Bay, migrate in the fall towards Hudson Strait or the Labrador coast, where they overwinter (Finley et al. 1982, Lewis et al. 2009). Molecular genetic studies indicate at least two separate stocks: a Western Hudson Bay stock and an Eastern Hudson Bay stock (Brennin et al. 1997, Brown Gladden et al. 1997, De March & Postma 2003). The relationships between these beluga and those found in James Bay, around the Belcher Islands, in northwestern Hudson Bay, and along the Ontario coast of Hudson Bay are unclear (Richard et al. 1990, Richard 2005, Gosselin et al. 2009).

Commercial whaling at various sites along the eastern Hudson Bay and Ungava Bay coasts during the eighteenth, nineteenth, and early twentieth centuries increased hunting pressure on northern Quebec beluga stocks (Doan & Douglas 1953, Finley et al. 1982, Reeves & Mitchell 1987a, Reeves & Mitchell 1987b). This activity probably initiated the decline of beluga stocks. Native people also harvest beluga along the northern Quebec coasts, and high subsistence harvests likely limited the potential for stocks to recover (Finley et al. 1982, Reeves & Mitchell 1987a, Reeves & Mitchell 1987b). Concerns for beluga in eastern Hudson Bay and Ungava Bay led to their designation as 'threatened' and 'endangered' by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Reeves & Mitchell 1989, Richard 1993).

Beginning in 1986, low estimates of beluga abundance in eastern Hudson Bay and Ungava Bay resulted in limits being placed on harvesting through a combination of quotas and seasonal and regional closures (Lesage et al. 2001, Lesage & Doidge 2005). Population modeling incorporating catch statistics since 1974, and fitted to aerial survey data for the period 1985–2001 indicated a decline in the number of beluga in eastern Hudson Bay by almost half since 1985 (Hammill et al. 2004). Based on these findings, more restrictive limits were placed on harvesting, including complete closures of eastern Hudson Bay and Ungava Bay in some years (Lesage and Doidge 2005; Table 1). In 2004, the status of Nunavik beluga stocks was reviewed by COSEWIC; the committee reaffirmed the 'endangered' status of the Ungava Bay stock, and designated as 'endangered' the Eastern Hudson Bay beluga (COSEWIC 2004).

Beluga harvesting in Nunavik is managed under agreements revised every four years. Management plans and beluga harvest statistics for Nunavik during 1974–2004 were reviewed elsewhere (Lesage et al. 2001, Lesage & Doidge 2005). A management plan was agreed upon for the period 2005–2008 and will be revised for the 2009 harvesting season. In this context, the current study reviews catch levels and characteristics in perspective of regional allocations for 2005–2008.

Materials and Methods

Statistics for beluga harvests in Nunavik have been collected systematically since 1974, although the degree of participation and quality of the information varied between communities and years (reviewed in Lesage et al. 2001, Lesage & Doidge 2005). Catch data during 1974 and 1975 were obtained *a posteriori* through questionnaires to hunters; those from 1976 to 1980 were obtained through weekly reports by individual hunters. It is unclear how catch data were obtained during the 1980–1984 period (see Lesage et al. 2001), but in 1985, beluga harvests were monitored on a daily basis using booklets distributed to individual hunters (Brooke & Kemp 1986). Beginning in 1986, community agents, and depending on years, personnel from Anguvigaq, Makivik, or Kativik Regional Government, assisted in monitoring beluga harvests through weekly and annual reports (Brooke 1992, Richard 1993, Olpinski 1993, Portnoff 1994, Brooke 1995, Brooke 1996, Brooke 1997, Brooke 1998, R. Fibich, Coordinator, Northern Quebec Affairs, Fisheries and Oceans Canada, for years 1998–2000). During 2001–2008, harvest statistics were obtained through weekly reports from community Fisheries Guardians (2001–2003) or Renewable Resources Officers (2004–2008) to the Kativik Regional Government, which were subsequently transmitted to D. Baillargeon or M. Gagnon, Coordinators for Northern Quebec Affairs, at Fisheries and Oceans Canada.

A sampling program to document the composition, seasonal and regional distribution of harvests exists since 1993. Hunters were provided data sheets and sampling kits, and were asked to indicate the gender and colour of each individual, location and date of harvesting. Hunters also collected a tooth for age determination and a skin sample for genetic studies (Turgeon et al. 2009). Sampling effort under this program varied between communities and years.

Harvest statistics during the pre-quota (1974–1985) and post-quota period were treated separately. Harvest data for the period 1974 to 1985 incorporated a correction for participation in the program (Native Harvesting Research Committee 1976; 1982a; 1982b; see Lesage et al. 2001 for details). For years 1986 to 2000, this correction does not appear to have been maintained, and reported harvests are meant to represent total harvests. Reported harvests for 2001-2008 are assumed to represent total harvests.

Harvest statistics were examined separately for four regions of the Nunavik, i.e., James Bay/Long Island (JB), eastern Hudson Bay (EHB), Hudson Strait (HS), and Ungava Bay (Figure 1). These divisions formed the basis of the two most recent management plans (2001–2004 and 2005–2008), and were inspired from recent information on seasonal movements and distribution of Eastern Hudson Bay and Western Hudson Bay beluga through sateilite telemetry (Lewis et al. 2009, P. Richard et al., Fisheries and Oceans Canada, Winnipeg, unpublished data). Beluga harvest locations were obtained through contributed samples or weekly community reports. Complementary information came from consultations with community mayors and representatives of the Hunters, Fishers and Trappers Association. When harvest location was unknown, regional harvest statistics were presented as a range of values: the minimum compiled only beluga with confirmed harvest locations while the maximum assumed that beluga killed in unknown locations were all harvested in the specified region.

Information on beluga colour and gender were available through weekly reports and sampling program. Only the latter source of data was used in this study. Age was determined, assuming the deposition of one growth layer group (GLG) per year (Stewart et al. 2006, but see Goren et al. 1987, Brodie et al. 1990, Lockyer et al. 2007, Luque et al. 2007). Tooth wear might bias age downward in older animals and was noted for each tooth, except in 1993, 1995 and 1997. The reader involved in age determination during the 1980s double-checked some of the ages obtained during 1993–2000 to insure consistency of the results.

Data and Discussion

Annual total and seasonal harvests, harvest trends and location

Over at least the past 35 years, beluga have been hunted in three main areas around Nunavik: eastern Hudson Bay, Hudson Strait, and Ungava Bay. While the hunt coincided mostly with the spring and fall migrations of beluga in Hudson Strait, catches concentrated mainly during summer in the other two areas, with only a few beluga taken during the spring or fall (Lesage et al. 2001). Catch statistics per community are available since 1974, and are summarized elsewhere for the period up to 2004 (Lesage et al. 2001, Lesage & Doidge 2005) and in Table 2 for 2005–2008. Annual catches varied between 1974 and 1985 from 204 to 723 beluga with an average 450 beluga/yr (Figure 2; Appendix 1). The introduction of quotas in 1986 reduced annual catches to an average 258 beluga/yr during 1986–2001 (range: 162–385 beluga/yr), and 175 beluga/yr after 2001 (range: 125–216 beluga/yr).

Hudson Strait historically supported the largest part of the harvest (Lesage et al. 2001, Lesage & Doidge 2005), and continued to support most of it during 2005–2008, when 69–92% of annual catches were obtained from this region (Table 2). One noticeable change initiated in 2001, and which continued through 2008, was an increase in the number of communities harvesting in Hudson Strait. This tendency was particularly obvious for Ungava Bay communities, most of which were harvesting part of their quota in Hudson Strait during 2001–2008, compared with only one or two communities doing so prior to 2001 (Table 2; Lesage et al. 2001, Lesage & Doidge 2005). Another change during this period was the appearance of a harvest in James Bay/Long Island area (4–13 beluga depending on years), which was

conducted mainly by communities from the Hudson Bay arc. In 2003 and 2005, there was also a harvest of 5 and 12 beluga in the King George/Belcher Islands.

These changes in hunting practices followed the introduction of more restrictive management measures in 2002 and the following years, which included: a reduction of total allocations, complete closure of eastern Hudson Bay and Ungava Bay to hunting during 2002–2006, with the exception of 2004 when a small catch was allocated in Ungava Bay in July (Table 1; see Lesage & Doidge 2005 for the period prior to 2005). As an alternate to harvesting in traditional locations, eastern Hudson Bay and Hudson Strait communities were offered allocations in sectors such as James Bay/Long Island area, Ottawa Islands, Belcher Islands, Nottingham and Salisbury Islands and other areas of Nunavut. Similarly, small allocations for winter harvesting were proposed to Hudson Strait communities.

Compliance with management measures improved in 2002 and the following years, as indicated by 1) a general reduction of catches (Figures 2 and 3), 2) a greater willingness to report catches through weekly reports in communities once reluctant to do so, and 3) participation in the sampling program by most of the communities. Regional allocations were followed during 2007–2008 in Ungava Bay, and in one of the two years in eastern Hudson Bay (Table 2). However, this was not the case in years when complete closure was imposed on communities of these two regions (2005 and 2006). Allocations were also exceeded in three of the last four years in Hudson Strait. To facilitate coordination among communities, regional allocations were distributed among communities prior to the beginning of the hunting season in 2007 and 2008 (Table 1). Nevertheless, 8 of the 14 communities exceeded their allocations in 2007 (Table 2). The 2007 management plan had provisions for reducing future regional allocations if full compliance was not achieved. As a result, allocations in Hudson Strait were reduced by 29 beluga to total 94 beluga in 2008; an additional reduction of the regional allocation by 19 beasts is planned for this region in 2009. Three of the 14 communities exceeded their allocation in Hudson Strait in 2008, but the regional allocation was not exceeded (Table 2). Beluga hunting was permitted near Ottawa Islands during 2005–2008, and near the Nottingham and Salisbury Islands in 2007 and 2008. However, no beluga were taken there. The winter harvest in Hudson Strait was cancelled in 2007 due to non-compliance with management measures earlier that year. A winter harvest was allocated in 2008, but no successful harvest has been reported to this date.

There were no seasonal restrictions on harvesting in Hudson Strait during 2005–2008 (Table 1). While Ungava Bay and Eastern Hudson Bay were strictly closed to hunting at all times in 2005 and 2006, allocations of 9 and 23 beluga at specific times during the year were afforded to communities from these two regions in 2007 and 2008 (Table 1). It was not possible to determine when beluga were harvested in specific regions based on the available summary reports. Consequently, compliance with management measures related to seasonal closures could not be evaluated with the data at hand. Seasonal closures are likely to become a recurrent management measure in the future. Data reporting format should be adjusted so to permit future evaluations of the effectiveness of these management measures.

Age and sex composition of catches

Of the 1021 beluga sampled in Nunavik waters between 1993 and 2008, 955 individuals had their colour qualified, including 286 during 2005–2008. Dark grey juveniles represented 8%, 10% and 5% of total harvests during 1993–2000, 2001–2004, and 2005–2008, respectively (Table 3). The proportion of grey or light grey beluga remained stable over the three periods at about one third of the harvest (34–40%). Similarly, white beluga dominated the catches during the three periods and accounted for 52–59% of the kills. Only 24 beluga were sampled in eastern Hudson Bay during 2005–2008. However, the representation of dark grey, grey and white beluga in the harvest was similar to that estimated for the entire sampling period or all regions combined, i.e., 8, 33%, and 58%, respectively.

This stability in the relative representation of various colour classes in the harvest was also reflected in its age composition. The latter was similar during 1993–2000 and 2001–2008 (Kolmogorov-Smirnov test: $D = 0.072$; $P = 0.38$), with half of the beluga killed being younger than 18 and 19 years-old, respectively (Figure 4). Similar results were obtained when considering only the most recent period (2005–2008), or when breaking down the 2000s harvest into two periods (Figure 5). Median age of the

kills varied among regions and was the lowest in EHB, with values of 16 and 17 years during 1993–2000 and 2001–2008, and 14.0 yrs during the most recent period (2005–2008), compared to values of 19–20 yrs and 18–22 yrs in Hudson Strait and Ungava Bay, respectively (Table 3; Figure 6). These differences in age distribution were tested statistically only for EHB vs Hudson Strait due to small sample sizes in Ungava Bay. Trends toward younger beluga in EHB compared to Hudson Strait were not significant both during the 1990s and 2000s (D = 0.176 and 0.224; P = 0.06 and 0.03, respectively) (Figure 7).

Sex was determined for 932 beluga sampled during 1993–2008, including 286 individuals for the period 2005–2008. The proportion of females relative to males in the harvest was not significantly different from unity during 1993–2008, or when periods were considered separately, i.e., 1993–2004, 1993–2000, 2000–2004 or 2005–2008 (χ^2, all $P > 0.05$; Table 4). However, the proportion of females in the harvest increased from 50.5% and 49.2% during 1993–2000 and 2001–2004, to 58.4% during 2005–2008 ($\chi^2 = 2.82$; $P = 0.09$). The overrepresentation of females in the harvest occurred as a result of a significant increase in the proportion of dark grey and grey juvenile females in 2005–2008, when they were taken more than twice as often as juvenile males (Table 4). This tendency to harvest young females was observed in eastern Hudson Bay and Hudson Strait during this period, but not in Ungava Bay. White females were also taken twice as often as white males in eastern Hudson Bay during the same period. In Ungava Bay, females have generally been slightly more abundant in the harvest than males, but the reverse was observed during 2005–2008 when males were killed significantly more often than females (but N = 9 beluga). Females and particularly grey females represent an important segment of populations. Management plans since 1996 specifically recommended that individuals with the highest reproductive values, *i.e.* reproductively active females and grey beluga, be protected. The tendency to harvest females and males indiscriminately and to harvest grey beluga was also observed prior to 2005 (Lesage et al. 2001, Lesage & Doidge 2005). Considering that grey individuals represent approximately one third of the harvest, and that grey and white females were taken more than twice as often as grey males, one can conclude that the management measures promoting the avoidance of females, and particularly grey females, have largely been inefficient in protecting these components of the population, particularly during the past four years.

The comparison of recent catches with those from the 1980s indicated that beluga harvested since 1993 were significantly younger than those harvested mainly in eastern Hudson Bay during the 1980s (median age = 26 yearsrs during 1980s vs 18 or 19 years during 1990s and 2000s: Kolmogorov-Smirnov tests: both $P < 0.0001$; Figure 4). This trend persisted when eastern Hudson Bay and Hudson Strait harvests were considered separately (Figure 6; Kolmogorov-Smirnov test for eastern Hudson Bay: $P < 0.0001$). The difference in the estimated age distributions between the 1980s and later years might have arisen from changes in the availability of older beluga. Given that the eastern Hudson Bay stock has declined since the 1980s, these results might be interpreted as an indication of a depletion of this stock. Alternatively, this trend might have resulted from a change in hunting practices or a change in the inshore/offshore distribution of adults. These different hypotheses were reviewed in details in a previous report (Lesage & Doidge 2005). However, if younger catches occurred as a result of stock depletion in eastern Hudson Bay, then one would expect catches to be composed of older beluga in Hudson Strait given that 80 to 90% of the beluga killed in this region come from healthy stocks such as western Hudson Bay (Turgeon et al. 2009). Another contradictory result comes from the proportion of grey individuals in the harvest, which was larger (49%) during the 1980s when harvested beluga were older, and smaller during the 1990s or 2000s (40 and 35%, respectively) when kills were composed of younger beluga. The reverse was observed for white beluga. Furthermore, although there was a higher proportion of beluga with worn teeth in the harvest of the 1980s compared to the 1990s (43% vs 21%), beluga with worn teeth were as frequent in the 1980s as during the 2000s (58%), even thus age distributions from these two periods were highly different. Clearly, further investigations are needed to clarify the consistency in age rating and determination among periods, and the distribution and availability of the various age classes to hunters in the various regions (reviewed in Lesage & Doidge 2005).

In summary, the introduction of quotas and other management measures stabilized total harvests, although regional and community quotas continue to be exceeded regularly. This study indicated that,

females and grey beluga (and grey females in particular) accounted for a larger than expected proportion of the harvest, and that beluga harvested in northern Quebec during 1993–2008 were younger than those landed in the 1980s. Although these results could indicate a depletion of the eastern Hudson Bay beluga stock, other factors (such as seasonal shift in the harvest) might have resulted in a change in the age distribution of harvests since the 1980s, and require further investigation.

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Table 1. Beluga management plans for the Nunavik region 2005–2008. Additional management measures are presented in the different source reports. Management plans prior to 2001 are presented in Lesage et al. (2001) and Lesage & Doidge (2005).

Region	Community	2005	2006	2007	2008
Eastern Hudson Bay (EHB)	Kuujjuaraapik			2 (10)[l]	2 (10)[l]
	Umiujaq			7 (5)[l]	7 (5)[l]
	Inujjuaq			7 (7)[l]	7 (7)[l]
	Puvirnituq			3 (11)[m]	3 (6)[m]
	Akulivik			4 (8)[m]	4 (5)[m]
	Regional allocation	**0**	**0**	**23[g]**	**23[g]**
	Other agreements	EHB closed	EHB closed	Nastapoka and Little Whale Rivers closed	Nastapoka and Little Whale Rivers closed
Hudson Strait (HS)	Ivujivik			15	14
	Salluit			15	8
	Kangirsujuaq			15	14
	Quartaq			15	15
	Regional allocation	135	135	120 5[f,j]	94 5[f]
Ungava Bay (UN)	Kangirsuk			1 (9)[m]	1 (6)[m]
	Aupaluk			1 (5)[m]	1 (3)[m]
	Tasiujuaq			1 (7)[m]	1 (7)[m]
	Kuujjuaq			1 (13)[m]	1 (9)[m]
	Kangirsualujjuaq			5 (7)[m]	5 (7)[m]
	Regional allocation	**0**	**0**	**9[h]**	**9[h]**
	Other agreements	Ungava Bay closed Mucalic River[b] closed	Ungava Bay closed	Mucalic River[b] closed	Mucalic River[b] closed
James Bay / Long Island	**Regional allocation**	**10**	**30**	**22**	**22**
Ottawa Islands	**Regional allocation**	**15**	**5**	**5**	**5**
Western Hudson Bay	**Regional allocation**	**25[c]** **25[d]**	**25[e]** **25[d]**		
Nottingham and Salisbury Islands	**Regional allocation**			**20[i]**	**20[k]**

[a] Beluga were to be taken outside of the Eastern Hudson Bay Arc
[b] Comprises the Whale, Mucalic, Tuctuc and Tunulic river
[c] Beluga were to be taken in the Belcher Islands area prior to July 1
[d] Beluga were to be taked in Western Hudson Bay

Table 1. Footnotes (continued)

[e] Beluga were to be taken in the Belcher Islands area prior to July 1 or after October
[f] Beluga were to be taken during winter (between 1 December and March 31)
[g] Particularly for Akulivik, it is preferable to hunt before July 1st. If impossible, the hunt should take place during the fall
[h] Hunting will take place in summer only, between July 1 and August 31
[i] Hunting will take place between September 1 and November 30
[j] Cancelled due to over-harvesting in Hudson Strait during the spring to fall hunting season
[k] Hunting will take place between July 1 and November 30
[l] Number in parentheses represent beluga to be taken in Long Island/James Bay
[m] Number in parentheses represent beluga to be taken in Hudson Strait

Table 2. Annual regional beluga harvests by the different communities of the Nunavik during 2005–2008.

Region	Harvest	Community	2005	2006	2007	2008
James Bay/Long Island		Umiujaq	2	8		
		Kuujjuaraapik	11	2	8	9
	N harvested		**13****	**10**	**8**	**9**
	Quota		**10**	**30**	**22**	**22**
Eastern Hudson Bay		Kuujjuaraapik				2
		Umiujaq			7	12**
		Inujjuaq			7	7
		Puvirnituq	1		2	2
		Akulivik			5**	5**
	N harvested		**1****		**21**	**28****
	Quota		**0**	**0**	**23**	**23**
Hudson Strait		Ivujivik	37	19	17**	12
		Salluit	23	19	33**	8
		Kangirsujuaq	14	16	16**	13
		Quartaq	15	20	13	17**
		Kangirsuk	8	17	14**	6
		Aupaluk	7	10	9**	4**
		Tasiujaq	9	16	7	5
		Kuujjuaq	15	16	19**	9
		Kangirsualujjuaq		8	2	10**
		Inujjuaq	1			
		Puvirnituq	15		23**	3
		Akulivik	28	6	12**	5
	N harvested		**172****	**147****	**165****	**92**
	Quota		**135**	**135**	**120**	**94**
Ungava Bay		Kangirsuk	2		2**	1
		Aupaluk	1		1	
		Tasiujaq	1	1		1
		Kuujjuaq		1	2**	1
		Kangirsualujjuaq	1		1	2
	N harvested		**5****	**2****	**6**	**5**
	Quota		**0**	**0**	**9**	**9**
Nunavut		Inujjuaq	12[a]			
	N harvested		**12[a]**	**0**		
	Quota		**25**	**25**		

** Indicates that the harvest exceeded the allocation

[a] Beluga harvested in King George Islands

Table 3. Various statistics on age and colour composition of the global and regional harvests during various periods.

Statistics	1980-1987				1993-2000				2001-2008				2001-2004				2005-2008			
	Total	EHB	HS	UNG	**Total**	EHB	HS	UNG	**Total**	EHB	HS	UNG	**Total**	EHB	HS	UNG	**Total**	EHB	HS	UNG
Colour																				
% dark grey	11	15	2	8	8	7	8	13	8	6	7	19	10	5	10	22	5	8	5	11
% grey	49	41	64	67	40	35	45	34	35	35	37	14	34	36	36	19	36	33	37	0
% white	40	44	33	25	52	58	47	53	57	59	56	67	56	59	54	59	59	58	58	89
Age																				
Median age	**26.0**	26.0	29.0	25.0	**18.0**	16.0	19.0	18.0	**19.0**	17.0	20.0	21.0	**19.0**	18.0	19.0	22.0	**20.0**	14.0	20.0	19.0
% unworn teeth	**57**	51	69	60	**79**	73	86	64	**58**	58	58	46	**61**	58	64	45	**52**	59	52	50
% teeth coming from each region		65	29	5		39	50	11		9	78	6		11	79	8		8	77	3

Table 4. Proportion of females relative to males in the harvest examined for all sectors and for various periods and sectors separately. Sex ratios that are significantly different from unity are indicated in boldface (chi-square statistics: $P < 0.001$).

Period	Colour	All sectors	Sector			
			Eastern Hudson Bay	Hudson Strait	Ungava Bay	James Bay/ Long Island
Globally						
1993–2008						
	Dark Grey	1.56 (69)	1.75 (11)	1.65 (45)	1.5 (10)	**0.5** (3)
	Grey	1.55 (326)	0.94 (68)	1.81 (225)	**2.20** (16)	1.80 (14)
	White	0.86 (518)	0.95 (109)	0.89 (321)	0.83 (42)	0.70 (39)
	Overall	1.10 (932)	0.97 (189)	1.21 (608)	1.13 (68)	0.84 (57)
1993–2004						
	Dark Grey	1.35 (54)	1.25 (9)	1.27 (34)	**2.00** (9)	1.00 (2)
	Grey	1.31 (222)	0.88 (60)	1.47 (143)	**2.20** (16)	**2.00** (2)
	White	0.80 (351)	0.85 (96)	0.83 (192)	0.89 (34)	**0.47** (25)
	Overall	0.99 (646)	0.87 (166)	1.08 (386)	1.27 (59)	0.58 (30)
1993–2000						
	Dark Grey	1.17 (26)	1.33 (7)	0.75 (14)	**4.00** (5)	- (0)
	Grey	1.32 (123)	1.53 (38)	1.15 (73)	**2.00** (12)	- (0)
	White	0.82 (162)	1.07 (60)	0.69 (81)	0.73 (19)	- (0)
	Overall	1.02 (313)	1.21 (106)	0.88 (169)	1.25 (36)	- (0)
2001-2004						
	Dark Grey	1.55 (8)	1.00 (2)	1.86 (20)	1.00 (4)	1.00 (2)
	Grey	1.30 (99)	**0.29** (22)	1.92 (70)	**3.00** (4)	**2.00** (2)
	White	0.78 (189)	0.57 (36)	0.95 (111)	1.14 (15)	**0.47** (25)
	Overall	0.97 (333)	**0.46** (60)	1.26 (217)	1.30 (23)	0.58 (30)
2005–2008						
	Dark Grey	**2.75** (15)	**2.00** (2)	**4.5** (11)	0.50 (1)	0.50 (1)
	Grey	**2.25** (104)	1.67 (8)	**2.73** (82)	- (0)	1.40 (12)
	White	1.01 (187)	**2.25** (13)	0.98 (129)	0.60 (8)	1.33 (14)
	Overall	1.40 (286)	**2.29** (23)	1.49 (222)	**0.50** (9)	1.25 (27)

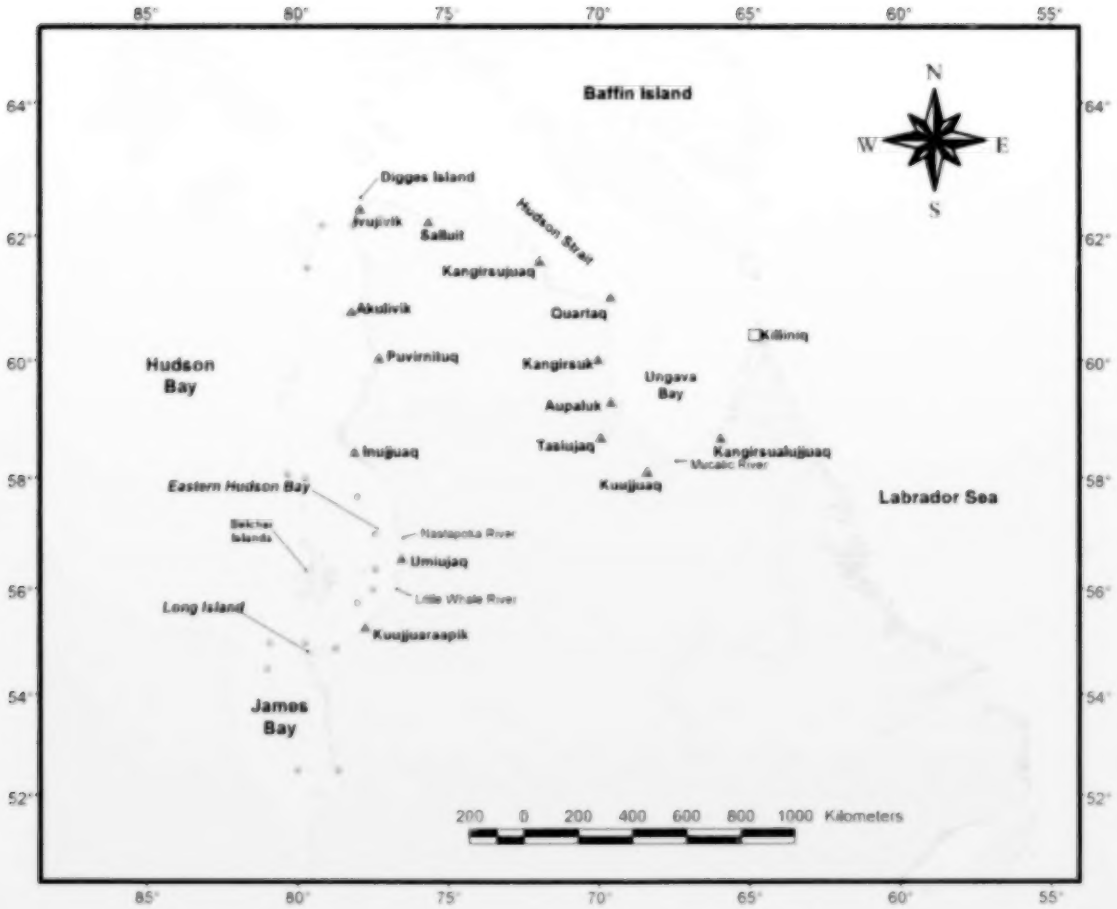

Figure 1. Regions considered in the analysis of the harvest statistics on beluga during 2005–2008. The limits among the three regions of James Bay, Long Island, and eastern Hudson Bay are indicated by the broken line. The other two regions are Hudson Strait and Ungava Bay.

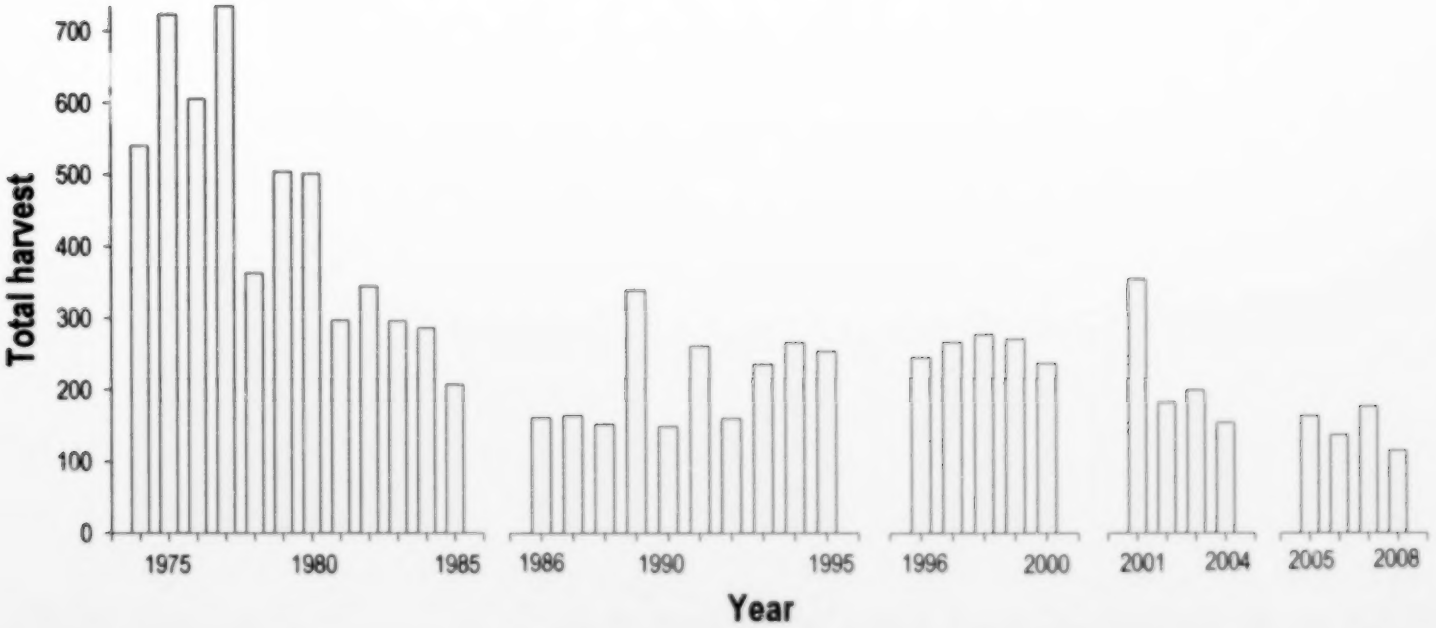

Figure 2. Beluga harvested by the Nunavik communities between 1974 and 2008. Data were compiled by the Native Harvesting Research Committee (1974–1980: used 'Estimate total harvest' from Native Harvesting Research Committee 1976; 1979; 1982a; 1982b), Anguvigaq Wildlife Management Inc. and Department of Fisheries and Oceans (1981–1985: Brooke & Kemp 1986), the Department of Fisheries and Oceans and, depending on years, Anguvigaq, Makivik or Kativik Regional Government (1986–1990: Richard 1993), the Department of Fisheries and Oceans and community agents or renewable resource officers (1991–2008: Brooke 1992, Olpinski 1993, Portnoff 1994, Brooke 1995, Brooke 1996, Brooke 1997, Brooke 1998 for years 1991–1997, and R. Fibich, D. Baillargeon or M. Gagnon, Coordinators, Northern Quebec Affairs for years 1998–2008). Information related to the methods of collection and treatment of harvest statistics is available from Lesage et al. (2001) and Lesage & Doidge (2005).

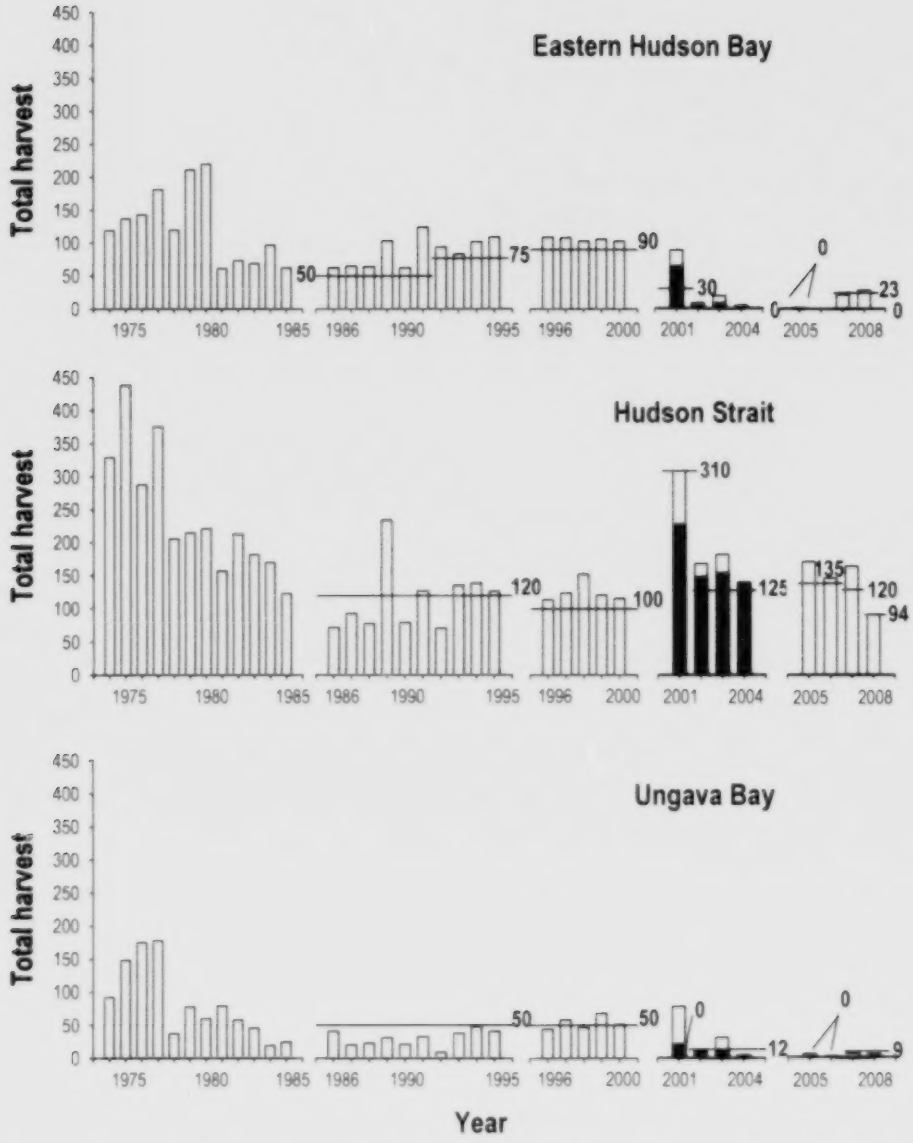

Figure 3. Total harvest of beluga relative to quotas (horizontal lines) in different regions of the Nunavik during 1974–2008. Harvest locations were either deduced from information on traditional hunting areas or obtained from beluga samples provided through the sampling program (1974–2000), or they were obtained directly from the hunters or provided samples (2001–2008). Stacked bars represent the minimum and maximum harvest, i.e., including harvests from unknown locations. Median catch levels over a management period were used for communities and years where catch levels were missing. Information related to the methods of collection and treatment of harvest statistics are available in Lesage et al. (2001) and Lesage & Doidge (2005).

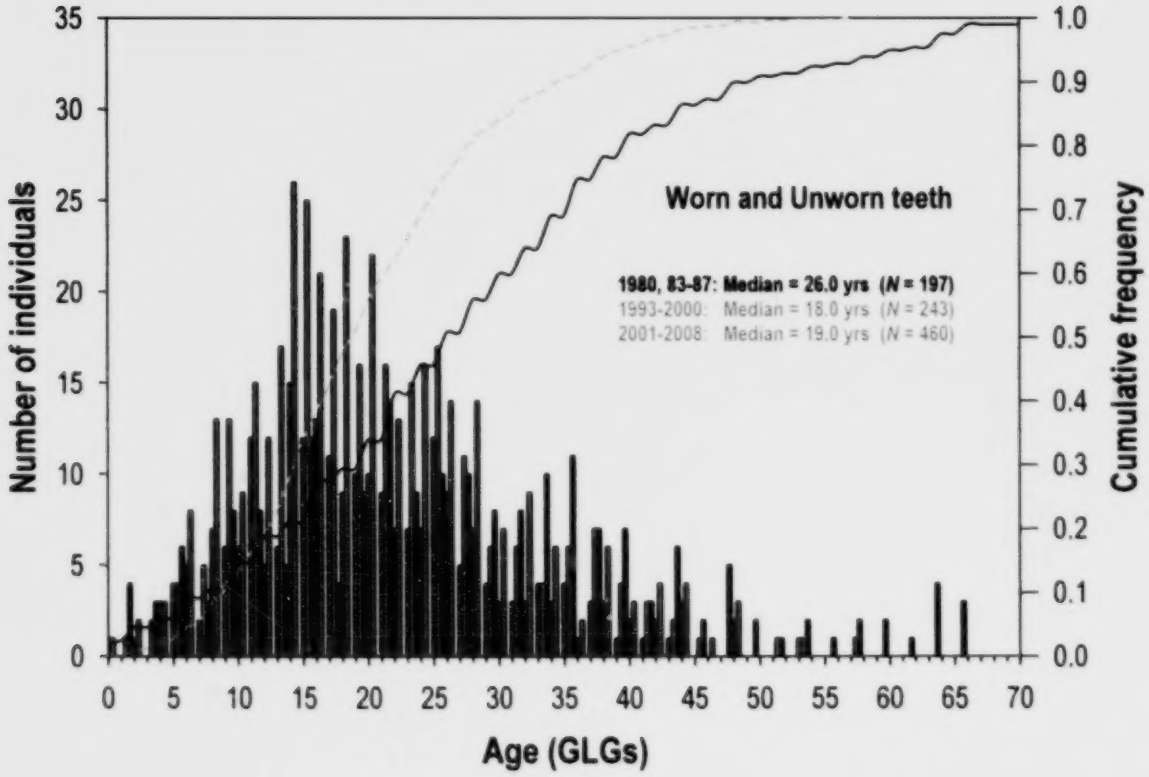

Figure 4. Age of beluga harvested in northern Quebec during 1980, 1983–1987 (black bars and plain curve; Doidge 1990), 1993–2000 (red bars and dotted curve), and 2001–2008 (green bars and dashed curve) presented as age frequencies (bars) and cumulative frequencies (curves), while using both worn and unworn teeth and assuming the deposition of one GLG per year. Two individuals from the 1980s, having 78 and 92 GLGs were not shown on the graph to improve clarity.

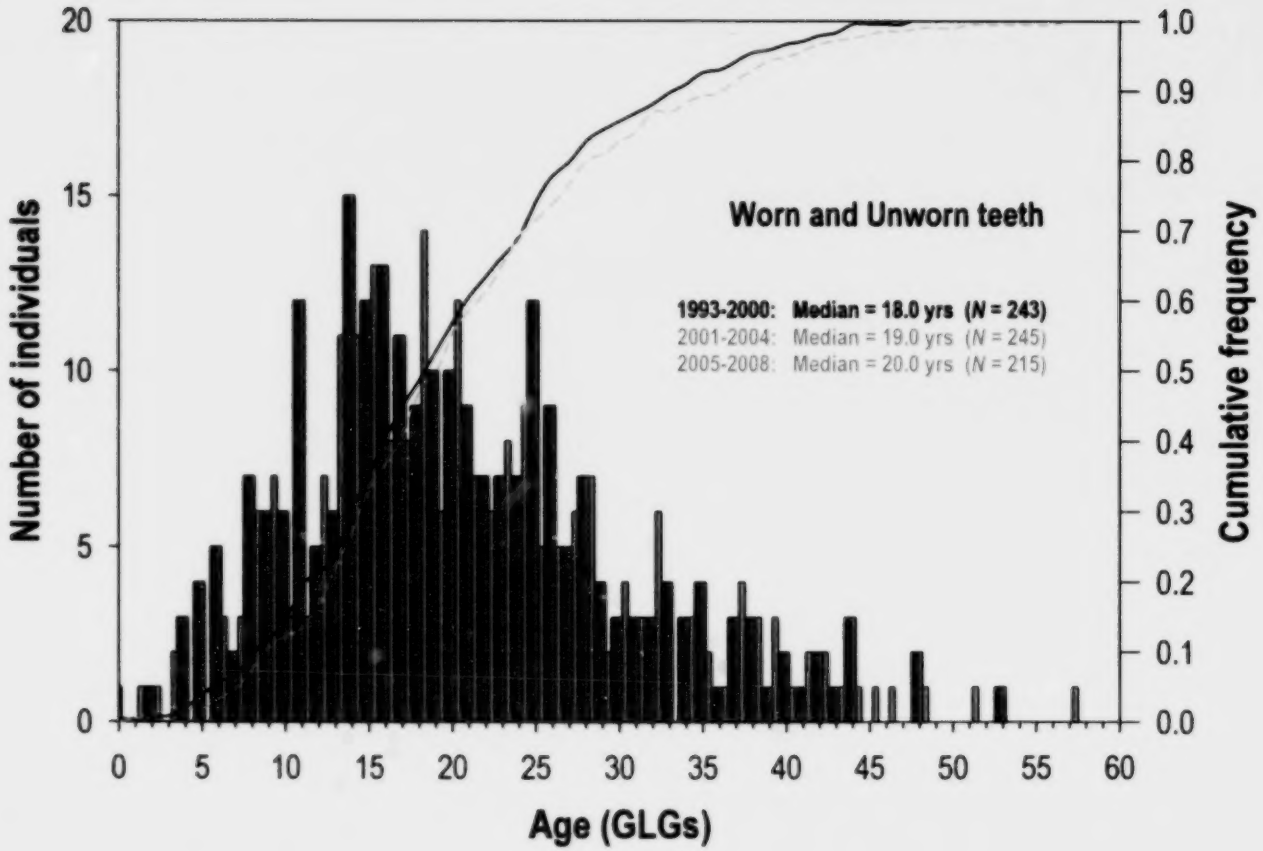

Figure 5. Age of beluga harvested in northern Quebec during 1993–2000 (black bars and plain curve), 2001–2004 (red bars and dotted curve), and 2005–2008 (green bars and dashed curve) presented as age frequencies (bars) and cumulative frequencies (curves), while using both worn and unworn teeth and assuming the deposition of one GLG per year.

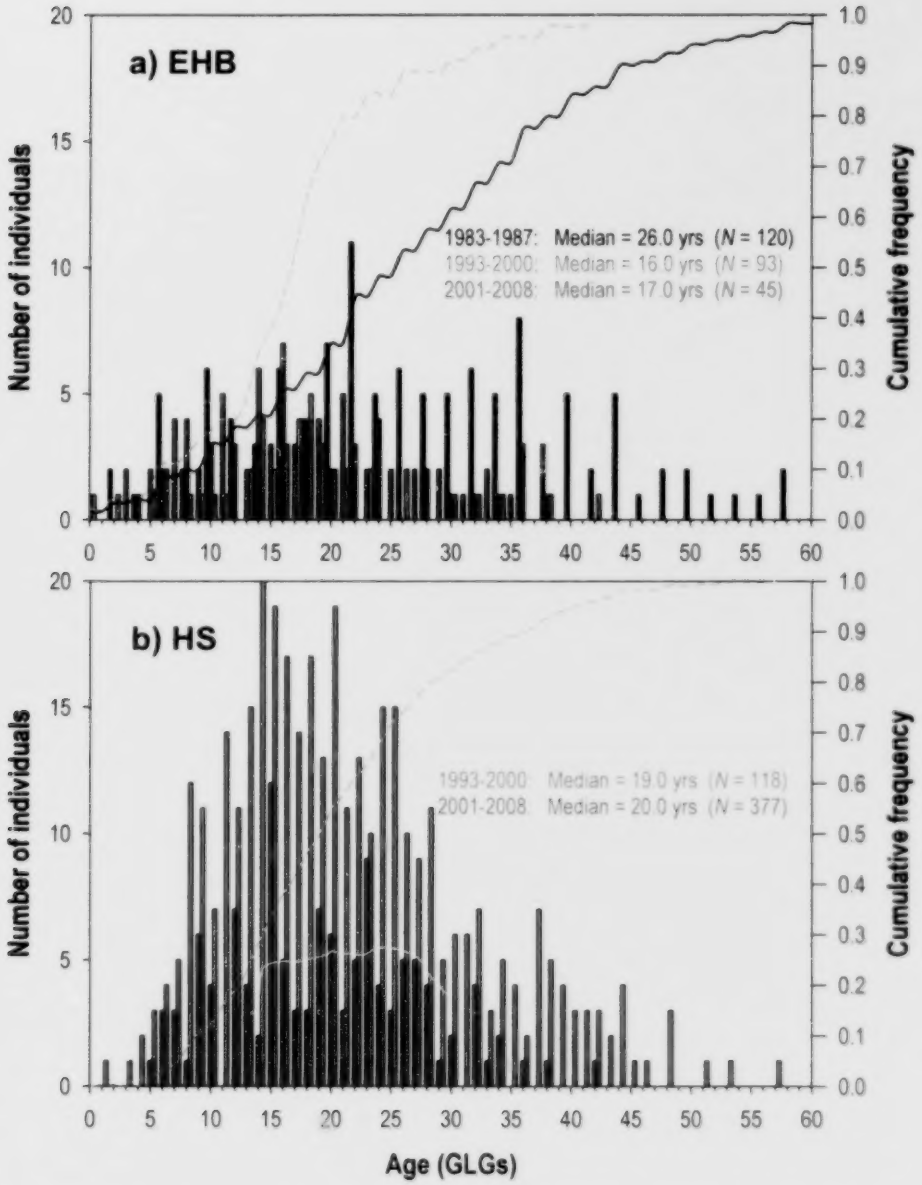
a) EHB
1983-1987: Median = 26.0 yrs (N = 120)
1993-2000: Median = 16.0 yrs (N = 93)
2001-2008: Median = 17.0 yrs (N = 45)
b) HS
1993-2000: Median = 19.0 yrs (N = 118)
2001-2008: Median = 20.0 yrs (N = 377)
Number of individuals
Cumulative frequency
Age (GLGs)

Figure 6. Age of beluga harvested in a) Eastern Hudson Bay (EHB) and b) Hudson Strait during the 1980s (black bars and plain curve; Doidge 1990), 1993–2000 (red bars and dotted curve), and 2001–2008 (green bars and dashed curve), presented as age frequencies (bars) and cumulative frequencies (curves), and using both worn and unworn teeth. In graph b), data for Hudson Strait during the 1980s were not presented due to small sample size (N = 7).

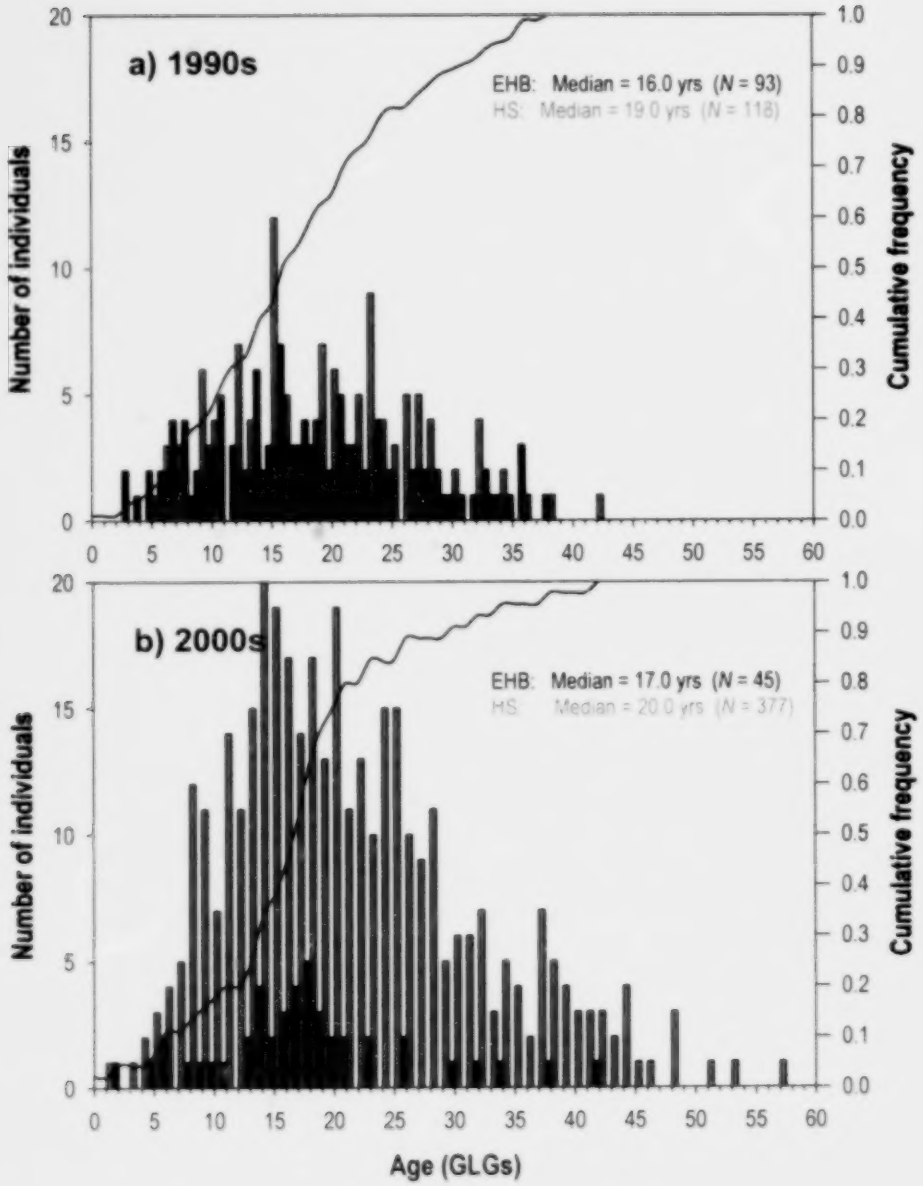
a) 1990s
EHB: Median = 16.0 yrs (N = 93)
HS: Median = 19.0 yrs (N = 118)
b) 2000s
EHB: Median = 17.0 yrs (N = 45)
HS: Median = 20.0 yrs (N = 377)
Number of individuals
Cumulative frequency
Age (GLGs)

Figure 7. Age of beluga harvested in a) 1993–2000 and b) 2001–2008 in Eastern Hudson Bay (black bars and plain curve), and Hudson Strait (red bars and dotted curve), presented as age frequencies (bars) and cumulative frequencies (curves), and using both worn and unworn teeth.

Appendix 1. Summary of beluga catches by the Nunavik communities, 1974–2008. Data were compiled by the Native Harvesting Research Committee (1974–1980: used 'Estimate total harvest' from Native Harvesting Research Committee 1976; 1979; 1982a; 1982b), by Anguvigaq Wildlife Management Inc. and the Department of Fisheries and Oceans (1981–1985: Brooke & Kemp 1986), community agents and depending on years, personnel from Anguvigaq, Makivik or Kativik Regional Government (1986–1990: Richard 1993), and community agents (or Renewable Resources Officers) and the Department of Fisheries and Oceans (1991–2008: Brooke 1992, Olpinski 1993, Portnoff 1994, Brooke 1995, Brooke 1996, Brooke 1997, Brooke 1998 for years 1991–1997, and R. Fibich, D. Baillargeon or M. Gagnon, Coordinators, Northern Quebec Affairs for years 1998–2008). Reports from 1991 to 2008 include animals that were struck and lost, but it is unclear whether these animals were accounted for in reports earlier than 1991.

Region	Community	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Eastern	Kuujjuaraapik	28	24	60	55	51	63	75	32	45	46	35	40[a]	10	11	0	8	8	12	16	12	22	14	15	11	14	14	8
Hudson	Umiujaq	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A[b]	3	15	12	18	12	24	24	19	18	21	19	19	18	24	19[l]
Bay	Inujjuaq	88	106	79	124	62	120	144	26	18	19	58	11	7	11	17	17	11	20	16	13	19	20	22	21	18	19	35
	Puvirnituk	-	-	-	-	-	-	-	-	-	-	-	-	-	16	23	41	22	50	22[g]	23	23	36	38	33	36	27	29
	Akulivik	3	7	4	2	7	28	1	3	10	4	4	11	12	12	12	19	9	18	16	16	20	18	15	24	17	22	12
Hudson	Ivujivik	-	-	-	-	-	-	-	58	126	69	69	35	5	24	19	118	20[h]	31	2[g]	37	-	38	34[j]	22	44	37	36
Strait	Salluit	84	159	66	104	36	42	50	57	41	53	29	22	24	20	16	53	17	28	19	37	46	40	32	46	54	33	28
	Kangirsujuaq	150	174	98	118	62	74	37	14	21	22	26	32	22	28	28	28	24	39	28	29	34	22	25	25	22	27	26
	Quartaq	26	36	55	85	39	30	65	28	25	38	46	34[k]	21	21	15	35	18	29	22	32	35	28	23	31	32	24	26
Ungava	Kangirsuk	37[f]	48[f]	44	79	10	4	4	14	9	12	3	7	9	8	7	11	10	12	3	12	10	10[d]	16	16	13	19	12
Bay	Aupaluk	N/A	N/A[f]	6	31	4	0[e]	0[e]	4	2	3	2	3	3	1	2	3	5	9	0	3	6	6	8	8	4	13	8
	Tasiujaq	4	9	3	23	0[e]	3	11	5	6	13	4	9	14	4	11	9	3	2	2	7	12	11	6	14	17	21	13
	Kuujjuaq	41	84	102	30	13	34	31	30	29	14	5	2	10	5	2	8	3	3	4	12	9	10	5	13	10	8	7
	Kangirsualujjuaq	10	27	20	15	10	37	14	26	12	3	5	3	5	2	1	0	0	7	0	4	11	2	9	7	3	7	11
	Killiniq[c]	0	15	9	16	-	-	-	-	-	-	-	8	1	0	4	-	-	-	-	-	-	-	-	-	-	-	-
	Total Nunavik	540	723	606	735	363	504	501	297	344	296	286	207	175	178	165	368	162	284	174	256	289	276	267	290	302	295	258

[a] Includes Umiujaq
[b] Community established in 1985
[c] killiniq closed in 1978, but some families resided there sporadically
[d] From Tables 3 and 4; erroneous reporting in Table 1 (Brooke 1996) carried over in following reports (Brooke 1997, Brooke 1998, R. Fibich, DFO, Laurentian Region, pers. comm. for years 1998–2000)
[e] inferred from non-zero rate of participation by the community (63–95%) since total harvest is absent from the harvest statistics (Native Harvesting Research Committee 1976; 1982a, b); zero value for the community is erroneously reported as missing data in subsequent reports (1981–2000)
[f] Includes Aupaluk ('Aupaluk not distinguished from Kangirsuk in 1974 and 1975', Native Harvesting Research Committee 1979)
[g] Unconfirmed harvest numbers
[h] R. Fibich, Department of Fisheries and Oceans, Northern Quebec Affairs, Laurentian region, pers. comm.
[i] Corrected for hunters unwilling to participate in the program
[j] Harvest is an estimate
[k] Monthly harvests sum up to 34 beluga, and not 32 as reported in total harvests (Brooke & Kemp 1986: p. 18)
[l] Umiujuaq community agent, pers. comm. to M.O. Hammill, Department of Fisheries and Oceans, Laurentian Region

Appendix 1. (Continued)

Region	Community	2001	2002	2003	2004	2005	2006	2007	2008
Eastern	Kuujjuaraapik	15	3	13	15	11	2	8	11
Hudson	Umiujaq	17	5	5	5	2	8	7	12
Bay	Inujjuaq	25	5	1[a]	0	1	0	7	7
	Puvirnituk	40	16	10[b]	19	16	0	25	5
	Akulivik	33	16	1	16	28	6	17	10
Hudson	Ivujivik	13	41	52	22	37	19	17	12
Strait	Salluit	57	21	18	21	23	19	33	8
	Kangirsujuaq	34	16	16	14	14	16	16	13
	Quartaq	60	34	34	18	15	20	13	17
Ungava	Kangirsuk	24	11	17	17	10	17	16	7
Bay	Aupaluk	7	3	10	7	8	10	10	4
	Tasiujaq	23	9	8	2	10	17	7	6
	Kuujjuaq	20	14	27	8	15	17	21	10
	Kangirsualujjuaq	17	4	5	4	1	8	4[c]	12
	Total Nunavik	385	198	216	168	178	149	192	125
	Total James Bay/Long Island	1	5	4-7		13	10	8	9
	Total Nunavut	-	-	5	-	12			

[a] Includes one beluga harvested in Labrador